Amendments to the Specification:

Please replace paragraph **[0003]** with the following amended paragraph:

[0003] Index matching fluids (IMF) have been widely used in fiber optic applications in order to reduce the reflection losses between optical components. They can take the form of liquids or gels, each having a substantial range of viscosity. The refractive index is one of the most important properties of an IMF, and for some optical systems, knowledge of the precise value is absolutely critical. Precise determination of **the** refractive index of liquid substances is also desired in non-optical fields, such as in the food and oil industries since the refractive index is often correlated with other properties and since it can often provide an easier way of indirectly measuring those other properties.

Please replace paragraph **[0008]** with the following amended paragraph:

[0008] As a second invention of the present application, a lens structure with a gap for receiving a sample is provided. The lens structure enables a light beam to be deflected in relation to the refractive index of the sample. In a first set of implementations, the sample is placed at an angle with respect to the light beam in the lens structure. In another set of implementations, the lens structure [[has]] comprises two lenses with optical axes that are angled with respect to one another.

Please replace paragraph **[0009]** with the following amended paragraph:

[0009] As a third invention of the present ~~application~~ **application,** a multi-lens structure for receiving two or more samples of the same material is provided. Each lens structure has a gap between two lenses, with at least two gaps being different in length. Optical properties of the two materials may be characterized over two different lengths of material, with lens components that are substantially matched in characteristics. The difference between samples

may be used to estimate various properties of the material, such as optical loss (*e.g.*, attenuation).

Please replace paragraph **[0021]** with the following amended paragraph:

[0021] FIG. 8 shows a relationship **[[of]]** **<u>between</u>** beam width and refractive index of the substance being measured according to the first present invention.

Please replace paragraph **[0030]** with the following amended paragraph:

[0030] FIG. 22 is a top view of **<u>an</u>** exemplary embodiment according to a third invention of the present application.

Please replace paragraph **[0031]** with the following amended paragraph:

[0031] FIG. 23 is a top view of **<u>an</u>** exemplary embodiment according to a fourth invention of the present application.

Please replace paragraph **[0035]** with the following amended paragraph:

[0035] FIGS. 1-6 show various views of a first embodiment of an exemplary apparatus and method according to the present invention ~~**where**~~ **<u>in which</u>** planar lenses are used. The first embodiment is shown **<u>in whole</u>** at reference number 10 ~~**in whole**~~ in FIG. 6. Common reference numbers are used in these figures to identify the elements of the apparatus. FIG. 1 shows a top plan view of an assembly 11 that holds a planar spreading lens 20 and a planar converging lens 24 on the top surface of a substrate 12. The lenses are held in a fixed relationship to one another with a gap 22 between them. Substrate 12 has a first side 13, and a second side 14 opposite to the first side 13. Light is preferably provided to spreading lens 20 by way of a ridge waveguide 18, which in turn can receive the light by a source integrated

onto substrate 12 or by a source external to substrate 12. FIG. 1 shows an embodiment ~~**where**~~ **in which** the light source is coupled from an optical fiber to waveguide 18 using any kind of fiber interconnect, which is designated in FIG. 1 by reference number 16. Fiber interconnect 16, when used, is preferably disposed near or at the first side 13. Other optical coupling arrangements may be ~~**use,**~~ **used,** such as optical focusing of light onto the left side of lens 20, which can be readily done when using the fixture (50) described below in greater detail with regard to FIG. 9. If using an integrated light source, the light source 5 would be moved to the position of fiber interconnect 16 in FIG. 6. Converging lens 24 is spaced from side 14 by distance D_0, which is explained below in greater detail. Between converging lens 24 and side 14, there is disposed an exit medium 28, which is typically air having an index of refraction of 1.0003. The area on the top surface of **[[the]]** substrate 12 located between lens 24 and **[[the]]** second side 14 and the exit medium **[[are]]** **is** free of obstructions to the wavelengths of light being emitted by source 5. In this figure, and in FIGS. 2 and 4-6, the center optical axis is denoted by reference number 15. The center optical axis 15 is also known as the principal optical axis.

Please replace paragraph **[0039]** with the following amended paragraph:

[0039] FIG. 6 is a top plan view showing assembly 11 disposed between a light source 5 and a beam profiler 30. Light source 5 is coupled to ridge waveguide 18 by way of optical fiber 6, which is held in place relative to waveguide 18 by fiber interconnect 16. FIG. 6 also shows a substance 1, whose refractive index is to be measured, disposed within gap 22. Also shown in FIG. 6 are capillary guides 26 disposed at the edges of lenses 20 and 24. Capillary guides 26 may comprise ridges of material that may be formed during the formation of lenses 20 and 24 (with the same material), or may be formed or attached after lenses 20 and 24 have been formed. Guides 26 provide an opening to substance 1 that is wider than distance L_G, and act to direct substance 1 to the faces of lenses 20 and 24 by capillary action. While two **[[pair]]** **pairs** of capillary guides are shown (one pair on either side of optical axis 15), one pair on one side of optical axis 15 would be sufficient to draw a liquid into lens gap 22. In

some implementations, such as when L_G is relatively wide, guides 26 are not needed. In still other implementations that do not need guides 26, a recess may be formed in substrate 12 in the general area where substance 1 is to be disposed, including the areas between the guides 26 shown in FIG. 6. The recess may take the general outline of substance 1 shown in FIG. 6, and **[[has]]** **may have** distal edges that are wider than distance L_G, thereby acting to direct substance 1 to the faces of lenses 20 and 24 by capillary action. An exemplary recess is shown at 27 in ~~**FIG. 1,**~~ **FIG. 2,** as outlined at one of its distal edges. While guides 26 are not needed for embodiments that use the recess, they nonetheless may be incorporated onto the substrate.

Please replace paragraph **[0040]** with the following amended paragraph:

[0040] The **[[Beam]]** **beam** profiler 30 has at least the ability to measure a width of the light beam presented to its optical capture window, and is oriented to measure the beam width in a direction which is parallel to the top surface of substrate 12. Many beam profilers are capable of measuring the beam width in two orthogonal directions, but this is not needed to make and use the present invention. Most beam profilers define the beam width as the distance between **[[the]]** two points on either side of the beam's maximum intensity point (*i.e.*, the center point), with the two points having intensities equal to a certain fraction of the beam's maximum intensity value. Typically, the value of that certain fraction is $1/e^2$ =0.135335, where e is the base of the natural logarithm (e=2.71828...). In other words, the light intensity at these two side points is equal to $1/e^2$ (0.135335) multiplied by the maximum beam intensity (at the center point). Instead of using the fraction of $1/e^2$, some profilers use the fraction ½ (**the** so-called "full-width, half maximum" definition), or allow the user to define the fraction. In addition, some profilers may define the width as the distance from the maximum intensity (at center) to one of the side points (or as the average of the two distances to the side points), but these definitions are not conventional. Nonetheless, the present invention may be practiced with any definition of the beam width. The inventors have practiced the present invention using a BeamScan® profiler manufactured by Photons, Inc.

This profiler is a slit-based real-time beam profiler, and uses a ~~**large-area**~~ **large-area** monolithic detector that collects light transmitted through a slit aperture as it passes through the beam.

Please replace paragraph **[0042]** with the following amended paragraph:

[0042] The variation in beam width with respect to distance Ds and refractive index of the substance for an exemplary embodiment is shown in FIG. 7. The parameters for this exemplary embodiment are provided below in Example 1. The curves in FIG. 7 may be generated by optical simulation software well known to the art (such as OptiBPM® by Optiwave Corporation), or may be measured empirically by using several substances of known refractive index, and by placing the profiler's scan head on a carriage that is moved on an automated rail, with the profiler measuring the beam width as it is moved away from **the** converging lens (in this case, D_0 is set at a small value, such as 1 mm). In the empirical approach, the beam propagation profile is preferably measured three or more times to avoid errors due to misalignment of the system, and the final curves are averaged. The beam width is then calculated after subtracting the background intensity.

Please replace paragraph **[0043]** with the following amended paragraph:

[0043] By extracting data along a vertical line in FIG. 7, such as along the vertical line of "distance from lens" = 35 mm, a relationship between beam width and refractive index of the substance can be generated (for that distance). Such a relationship is shown at 40 in FIG. 8. The vertical line used to extract data from FIG. 7 is preferably located near the greatest divergence in the data curves, and the lens system components 20, 22, and 24 are preferably designed to provide a beam width of at least 100 μm in this area. Relationship 40 is a monotonic relationship that relates the measured beam width (at a given distance D_S) to the

refractive index of the substance 1 being measured. By taking the measured beam width, one may draw a horizontal line across the graph, with the horizontal line intersecting the beam-width axis at the measured value of beam width. The horizontal line intersects relationship 40 at a point, and a vertical line may be drawn from this point down to **the** refractive-index axis. The intersection of the vertical line with the refractive-index axis gives the corresponding value of the substance's refractive index. In general, profiler 30 has error in its measurement process. For example, when using BeamScan® profiler manufactured by Photons, Inc. for profiler 30, the beam width can be measured with **an** accuracy better than ± 2%, which is approximately ±5 μm for a mean beam width of 250 μm. As shown in FIG. 8, one may bracket the measure value with dashed lines representing the upper and lower error bounds. These dashed lines intersect relationship 40, and corresponding vertical dashed lines to the refractive-index axis may be drawn in order to generate error bounds on the refractive index value.